MISCELLANEOUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

49. Proposed by J. SCHEFFER, A. M., Hagerstown, Md.

Give a general proof that the centre of gravity, or centroid, determines that point from which the sum of the distances to all other points of a given area is the minimum.

This problem is almost the same as No. 30, Miscellaneous, solutions of which were published on pages 334-5 of Vol. II, and on pages 86-88 of Vol. III. No further solutions have been received. If any of our contributors will attempt other solutions, they will be given in a future number. EDITOR.

50. Proposed by JOHN KEELEY ELLWOOD, A. M., Principal of the Colfax School, Pittsburg, Pa.

Describe and compute the actual path traversed by the moon in July and August, 1896, taking into account the motion of the earth around the sun.

No solution of this problem has been received. Dr. S. Hart Wright remarks that "a solution is not possible, as the *actual* path of the moon in space is required, while the moon and the earth describe, in their orbits, neither circles nor ellipses, but curved lines that are *undulatory*, being affected by perturbations due to other planets. If the orbits of the earth and moon were circles or ellipses, the moon's path would be an epicycloidal curve, always concave towards the sun." With the aid of a Nautical Almanac or data of the moon's path during the time asked, it would seem that a practically correct solution of the problem could be effected. We shall be pleased to publish anything further from contributors on this problem. EDITOR.

51. Proposed by F. M. SHIELDS, Coopwood, Miss.

A stock dealer traveled from his home H, due north across a lake L 40 miles wide to a city, and bought 156 horses and 177 mules for \$23631; he then traveled farther due north to A, and bought at same price 468 horses and 235 mules for \$52245; he then traveled from A due west 130 miles to B, and bought 120 cows; he then traveled due north to C, and bought 250 sheep; he then traveled from C due east 330 miles to D, and bought 300 goats,—paying 1-4 as much for cows as horses, and 1-9 as much for sheep as mules, and 1-2 as much for goats as sheep; at D he turned and traveled in a straight line to the city, a distance equal to the sum of the entire distance he traveled due north from his home H; he sold all his stock at a profit of 20%. How far did he travel from his home H the entire trip around and back to the city? What was the cost of each head of stock, and what was the entire gain?

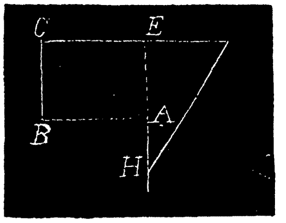
I. Solution by P. S. BERG, A. M., Principal of Schools, Larimore, N. D.; CHARLES C. CROSS, Laytonsville, Md.; H. C. WILKES, Skull Run, W. Va.; J. SCHEFFER, A. M., Hagerstown, Md.; and G. B. M. ZERR, A. M., Ph. D., The Russell College, Lebanon, Va.

Let x=price of each horse, y=price of each mule.

Then $156x+177y=23631$; and $468x+235y=52245$.

$\therefore\ x=\$80,\ y=\$63.$

$\frac{1}{4}$ of \$80=\$20, price of each cow ; $\frac{1}{9}$ of \$63=\$7, price of each sheep ; $\frac{1}{2}$ of \$7=\$3.50, price of each goat. $120\times20=2400$; $250\times7=1750$; $300\times3.50=1050$.



\$2400+\$1750+\$1050+\$23631+\$52245 =\$81076, entire cost. 20% of \$81076=\$16215.20, entire gain.

Let $AH=u$, $BC=v$.

$\therefore\ (40+u+v)^2=(u+v)^2+(200)^2.$

$\therefore\ u+v=480$ miles.

$\therefore\ 480+40+480+40+330+130=1500$ miles.

II. Solution by M. A. GRUBER, A. M., War Department, Washington, D. C.

Draw a diagram of the traveling, and produce line HA to E in line CD. Represent the city by O. Then OED be a right triangle in which $ED=330-130=200$ miles.

Put a=distance from home to city. Let $x=OE$; then $OD=x+a$.

Whence $(x+a)^2=x^2+200^2$.

$$\therefore\ x=\frac{200^2-a^2}{2a},\ =\frac{200^2}{2a}-\tfrac{1}{2}a.$$

Now, in order that x may be positive, $\frac{1}{2}a<200^2/2a$; whence $a<200$.

But as the lake is 40 miles wide, a can not be less than 40. Therefore for positive values of x, a may have any value from 40 to 200.

The distance due north$=\dfrac{200^2-a^2}{2a}+a=\dfrac{200^2+a^2}{2a}$; and the entire distance traveled$=\dfrac{200^2+a^2}{a}+460$.

When $a=40$, or if H and O are situated on the lake, the entire distance traveled=1500 miles.

When $a=200$, $x=0$, and the city is the farthest north traveled. A would then coincide with O, and C with B.

When $a>200$, x is *negative*. Instead of traveling north from the city, he would then go west from the city to B, and thence *south*, the value of x, to C. For *any* positive value of x, A may be at any point in a due north line between O and E.

Let h, m, c, s, and g be the cost per head, respectively, of horses, mules, cows, sheep, and goats. Then $156h+177m=\$23631$, (1) ; $468h+235m=\$52245$, (2) ; $c=\frac{1}{4}h$, (3) ; $s=\frac{1}{9}m$, (4) ; and $g=\frac{1}{2}s$, (5). From (1) and (2), $h=\$80$, and $m=\$63$. Whence $c=\$20$, $s=\$7$, and $g=\$3\frac{1}{2}$.

$\therefore$ The stock cost \$23631+\$52245+\$2400+\$1750+\$1050=\$81076.

By selling his stock at a gain of 20%, he gained $\frac{1}{5}$ of \$81076=\$16215.20.

Also solved by *E. W. MORRELL*, and *JOSIAH H. DRUMMOND, LL. D.*